BRADY et al
Application No. 09/936,998
Response to Office Action dated October 4, 2005

REMARKS

Reconsideration and allowance of the subject patent application are respectfully requested.

Applicants acknowledge with appreciation the indication that claims 31 and 32 contain allowable subject matter.

Claim 40 has been amended to address a minor informality.

Claims 24-30, 35-39 and 42-44 are rejected under 35 U.S.C. Section 103(a) as allegedly being "obvious" over the Cham et al. document ("A Statistical Framework for Long-Range Feature Matching in Uncalibrated Imaging Mosaicing") in view of Martens (U.S. Patent No. 6,157,677).

The office action addresses three separate points. First, the office action alleges that Cham discloses storing a plurality of candidate motions. Second, the office action alleges that the term "neighbouring" in the claims could be considered to be any pixel within the image. Third, the office action alleges that the examples in Cham include non-rigid objects.

Each of these points will be discussed below.

With respect to the term "neighbouring" used in the claims, Applicants have adopted the Examiner's helpful suggestion (see 10/4/2005 Office Action, page 3) to replace "neighbouring" with "adjacent." It is clear, and, from the nature of the statements in the office action, the Applicants believe that the Examiner agrees, that Cham does not disclose recalculating the probability of candidate movements at one sampling point with the probabilities of candidate movements at adjacent sampling points. For this reason alone, Applicants believe that the obviousness rejection is overcome because no other art discloses this feature, and consequently there is no combination of documents which would have provided the presently claimed methods and apparatuses.

By way of further explanation, Applicants note that Cham is interested in a method which mosaics together several fragmentary images to form a complete one, as shown in Cham's Figures 5 and 6. This might be to create one "panoramic view" from several separate pictures. Thus Cham aims to find the region of overlap between the pictures, and join them together accurately. In doing this, Cham selects a point in one of the fragments and a point in another of

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the fragments and regards these as a candidate match (or candidate pair). Several such candidate pairs are found, and they are found randomly from anywhere in the pair of fragments under consideration. In fact, in Cham it is likely that a better mosaicing of two image fragments will be obtained if several feature pairs can be selected which are quite widely spaced apart. If one imagines trying to mosaic two fragments together, by using only one matching point, the two images could clearly be mosaiced in a variety of (rotational) orientations, as long as the single matching point matches. On the other hand if one also matches a number of other candidate matching pairs which are widely spaced apart, the mosaicing is likely to be more accurate.

It is also important to understand that with Cham the whole fragment would be moved to achieve the desired match. In contrast, in the context of the pending claims, the images are of a body which is undergoing non-rigid movements. Consequently matching is preferably conducted locally. Different parts of the body (e.g., a breast) may move in different ways and so the same transformation does not generally apply to different parts of the body. This is quite different from Cham where the same (rigid) transformation is applied to the whole image. As described without limitation in the subject application in connection with example embodiments, each local area within the image can have its own transformation, and a global transformation field for the whole image includes all of those different local ones together. Thus the fact that the claims describe using probabilities of candidate movements at adjacent sampling points to recalculate the movement at the sampling point under consideration is related to the fact that it is trying to detect non-rigid movement in the object which is inherently local. Cham is not attempting to detect such non-rigid movement (and is incapable of doing so). Consequently, Cham lacks this feature and there is no need to provide it.

With respect to rigid and non-rigid bodies, the office action alleges that the example images in Cham include people and trees (and even relatively rigid objects such as furniture or buildings) which could be viewed, to varying extents, as being non-rigid. Consequently the independent claims have been amended to clarify that "non-rigid movement" of a body is detected. A non-rigid body can move rigidly or non-rigidly, and the claims are concerned with detecting non-rigid movement, e.g., deformation. This is entirely consistent with the disclosure of the subject patent application which, for example, makes various references to "non-rigid movement." See, e.g., page 2, line 12 and page 2, line 25.

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Although the office action indicates that Cham "at least allows for non-rigid motion", Applicants believe that it is important to note that in detecting the transformation between the two fragmentary images, Cham has to detect features which match. Consequently Cham needs to detect a shape in one fragment which is also found in the other one. This is clearly indicated at page 444 in the third to sixth lines of Section 2.3 which say:

"The features may also be of various classes (e.g. corners, lines, regions)".
It is these candidate feature pairs which represent candidate transformations.

Moreover, it is important to note that Cham is trying to mosaic two images, in other words to find the rigid transformation, for example a translation or rotation, which connects one fragmentary image to another. Cham is not concerned with non-rigid movement or transformations which reflect non-rigid movement. Cham would have to ignore any non-rigid movement of objects in the scene. Instead, Cham is concerned with a long range rigid transformation.

With respect to storing of all candidate movements, the office action points out that in Cham, at a particular resolution level, several candidate movements are stored, and alleges that this corresponds to the feature in the claim that a plurality of candidate movements are stored. Cham does store a plurality of candidate transformations (movements), and a probability is stored for each of them. However, Cham does not disclose that the probability of one of the transformations is updated by the probability of another one.

Claim 24 and the other independent claims all involve storing for each sampling point the probability for each of a plurality of candidate movements, and recalculating the probability of each candidate movement for each sampling point based on the probability of candidate movements at adjacent sampling points.

Cham does not disclose these features. In particular, Cham does not update one candidate movement by the probability of other candidate movements at other sampling points. The fact that Cham discloses storing a plurality of different candidate movements (different candidate pairs) and stores a probability for each of them, is not a disclosure or suggestion of these features of the independent claims. Cham does not disclose or suggest that the probability for one candidate movement is used to update the probability of another. This difference can allow the methods and apparatuses of the pending claims to register images of bodies which are

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undergoing non-rigid movement, without, for example, the process being trapped in local minima. It means, for example, that a candidate movement which initially appears unlikely, may actually have its probability increased with successive re-calculations because of the candidate movements at adjacent sampling points.

Because the above-discussed features are not disclosed in Cham nor in any of the other prior art cited, Applicants believe that the claims patentably distinguish over the applied documents.

Because the amendments herein correct an informality, adopt the Examiner's suggestions and/or provide clarification to the claimed subject matter, no new issues are believed to be raised. In addition, these amendments are believed to place the application in condition for allowance. As such, entry of the amendments is believed to be appropriate and is respectfully requested.

The pending claims are believed to be allowable and favorable office action is respectfully requested.

Respectfully submitted,

NIXON & VANDERHYE P.C.

By: _____
Michael J. Shea
Reg. No. 34,725

MJS:mjs
901 North Glebe Road, 11th Floor
Arlington, VA 22203-1808
Telephone: (703) 816-4000
Facsimile: (703) 816-4100